The great challenge of our time is to build and nurture sustainable communities—communities that are designed in such a way that their ways of life, businesses, economies, physical structures, and technologies do not interfere with nature's inherent ability to sustain life. The first step in this endeavor is to understand the principles of organization that ecosystems have developed to sustain the web of life. This understanding is what we call ecological literacy.
– Fritjof Capra

What is Ecological Literacy?

Ecological literacy, or eco-literacy, is a term first used in the 1990s by American educator David W. Orr and physicist Fritjof Capra to introduce into educational practice the value and well-being of the Earth and its ecosystems. It is a way of thinking about the world in terms of its interdependent natural and human systems, including a consideration of the consequences of human actions and interactions within the natural context. Ecological literacy equips students with the knowledge and competencies necessary to address complex and urgent environmental issues in an integrated way, and enables them to help shape a sustainable society that does not undermine the ecosystems upon which it depends.

The following are core aspects of ecological literacy:

1. Principles of living systems
2. Design inspired by nature
3. Systems thinking
4. Ecological literacy and the transition to sustainability
5. Collaboration, community building, and citizenship

Students understand the natural systems that sustain life on earth and apply the principles guiding ecosystems to help create sustainable human communities.

1. Principles of living systems

According to Fritjof Capra, the ecological problems facing society are rooted in a lack of understanding of our place in the web of life. A key part of eco-literacy is reconnecting students to living systems—what educator Linda Booth Sweeney calls developing a "connected wisdom." Living systems are open, self-organizing systems that have the special characteristic of life and that interact with their environment through information and material-energy exchanges.

Examples of living systems include the human body, a forest, or a river, as well as human-created organizations such as communities or schools.

Connecting students to natural systems provides them with a deep sense of place and an understanding of their local environment. While students are immersed in experiences of the natural world as part of their classroom learning, they discover and study the principles guiding the functions of natural systems. On her website, Linda Booth Sweeney outlines two different approaches to describing the principles of living systems, including their

dynamic, complex, cyclical nature and their inherent interconnectedness. (See *Living System Principles* at www.lindaboothsweeney.net/thinking/principles and *Ecological Principles* at www.ecoliteracy.org/nature-our-teacher/ecological-principles.)

These principles come from the study of ecosystems and from a growing understanding of the way they have evolved over time. They also draw on the approaches of traditional and indigenous societies, many of whom have thrived for centuries by applying these ecological principles.

2. Design inspired by nature

The guiding principles and characteristics of living systems serve as a basis for envisioning and designing sustainable communities. Beyond understanding natural systems, ecological literacy is about applying this understanding to the redesign of organizations, communities, businesses, and societies to align with ecological principles. The idea of "design inspired by nature" has become popular through concepts such as *biophilia*, *biomimicry*, or *biomimetics*, which involve examining and emulating natural models, systems, processes, and elements in order to solve human problems. According to David Orr, the goal of ecological design is to transform how humans act in the world to provide food, shelter, energy, materials, and seek their livelihood.
Ecological literacy asks what people know and how they should learn it, given the limits of Earth and its systems. It demands that human actions and design conform to how the world works as a biophysical system, and that societies be designed with future generations in mind.

3. Systems thinking

Ecological literacy is also guided by an understanding of systems, or systems thinking (sometimes called holistic or relational thinking). Because a system is a set of interdependent, interrelated parts that make up a complex and unified whole, it cannot be fully understood by analyzing its constituent parts. Ecological literacy involves applying a way of thinking that emphasizes relationships, connectedness, and context. For example, we can only understand a songbird by exploring both its own characteristics as well as its interactions with the watershed where it lives. Systems operate on multiple scales, with systems nested within systems. A watershed is a vibrant interplay among species from the tree to the bacteria in the soil. Systems thinking is necessary to understand the complex interdependence and often unpredictable dynamics of ecological systems, social systems, economic systems, and other systems on all levels. Ecologically literate students find connections in seemingly disjointed problems, perceive patterns instead of pieces, and design communities based on the interrelatedness of all life.

Science lessons about the water cycle or a food web are building blocks of ecological literacy because they reveal to the student how nature works. Likewise, a social studies unit on a human community (e.g., a family, neighbourhood, region, or country) or a geography lesson on resource management contribute to ecological literacy as soon as the dependence and impact of the human system/community/region on natural systems is acknowledged and explored as a vital part of the story.
– Ecological Literacy Resources for the Classroom Teacher
http://toes.tdsb.on.ca/ecological_literacy_resources.asp

Thinking systemically requires a number of "habits of mind." This concept was outlined in Linda Booth Sweeney's *Habits of Systems Thinkers* at www.lindaboothsweeney.net/thinking/habits and in *Habits of a Systems Thinker* by the Water Foundation at http://watersfoundation.org/systems-thinking/habits-of-a-systems-thinker/. These habits include seeing the whole of a system rather than snapshots of its parts, looking for patterns and connections, and uncovering and testing assumptions. This also involves a shift in perception, from a focus on parts to a focus on the whole or from discrete objects to relationships within a system. A version of this shift in perception is captured in *Systems Thinking: Shifts in Perception* by the Center for Ecoliteracy. It is available at www.ecoliteracy.org/nature-our-teacher/systems-thinking.

4. Ecological paradigm and the transition to sustainability

> *The dialogue about sustainability is about a change in the human trajectory that will require us to rethink old assumptions and engage the large questions of the human condition that some presume to have been solved once and for all. Genuine sustainability, in other words, will come not from superficial changes but from a deeper process akin to humankind growing up to a fuller stature.* – David W. Orr

Ecological literacy is partly aimed at triggering large-scale social change in how humans live on the planet. Teaching young people that we are part of the natural world is the basis for the shift to an ecological paradigm—a world view that places humans as embedded in ecological systems rather than perceived as separate, and that recognizes that there are global constraints to the amount of resources we can use and the amount of waste we can produce on a finite Earth. As Fritjof Capra notes, "in the coming decades, the survival of humanity will depend on our ecological literacy—our ability to understand the basic principles of ecology and to live accordingly." This shift to an ecological paradigm is part of a transition to sustainability—accounting for human well-being while substantially reducing poverty and conserving the planet's life support systems. Sustainability is not just about basic needs and human survival; sustainability is the process to create a vibrant society. The Center for Ecological Literacy notes:

> *A truly sustainable community is alive — fresh, vital, evolving, diverse, dynamic. It supports the health and quality of life of present and future generations while living within the limits of its social and natural systems. It recognizes the need for justice, and for physical, emotional, intellectual, cultural, and spiritual sustenance.*

This is about the ethics guiding human society, including taking responsibility for the social and environmental consequences of our activities.

Daniel Goleman uses the term *ecological intelligence* to highlight the need for feedback about whether our activities are having a positive or negative impact on people and ecosystems. He makes the point that there is an urgent need for marketplace transparency and for greater human understanding of the ecological impacts of how we live. New information technologies provide a tool for assessing the sustainability of supply chains and the far-flung impacts of our choices. He notes that "we can, together, become more intelligent about the ecological impacts of how we live—and how ecological intelligence, combined with marketplace transparency, can create a mechanism for positive change."

The exchange of information is only one aspect of this ecological intelligence. Goleman notes that we also need to draw on our social intelligence to coordinate and harmonize our efforts because of the complex global web of cause and effect.

Ecological intelligence allows us to comprehend systems in all their complexity, as well as the interplay between the natural and man-made worlds. But that understanding demands a vast store of knowledge, one so huge that no single brain can store it all. Each one of us needs the help of others to navigate the complexities of ecological intelligence. We need to collaborate.
– Daniel Goleman

5. Collaboration, community building, and citizenship

Ecological literacy is about emphasizing collaboration and partnership as a hallmark of living systems and life. The ability to associate, create links, and draw on the collective distributed intelligence of many individuals is part of eco-literacy. Ultimately, sustainability is a community practice.

Ecologically literate students are also community builders and active citizens. An ecological education occurs both within the natural environment and in the local community where students can build relationships and apply their understanding in a real-world setting.

Ecoliteracy knowledge empowers students to help create a better society and make a difference. Studies have shown that combining civic engagement and ecological literacy creates leaders who are willing to participate as citizens in effecting positive change and engaging in creative solutions.

Ecological literacy in a global issues course

The Center for Ecoliteracy suggests the following principles for the integration of ecological literacy:

- Ecological literacy is not an additional concept or subject to be added to the content of the course. It may be seen rather as a perspective or a way of thinking through which any selected topic or Issue may be viewed.
- It is useful to focus on guiding fundamental questions, which may recur and open up conceptual links across disciplines (e.g., science, geography, anthropology, politics, history, the arts, sociology, health).
- The conceptual links that tie subjects together help make learning more effective, since they lead to learning that is more readily applicable to the real world.
- Taking a hopeful, proactive approach and designing learning activities that engage students in potential solutions are important when teaching about environmental issues.

Core competencies for ecoliteracy

The Center for Ecoliteracy (www.ecoliteracy.org/discover/competencies) has developed a set of core competencies to help young people develop and live in sustainable communities. These competencies relate to the head *(learning to know*), the heart (*learning to be*), the hands (*learning to do*), and the spirit (*learning to live together*).

Head (Cognitive)

- Approach issues and situations from a systems perspective
- Understand fundamental ecological principles
- Think critically, solve problems creatively, and apply knowledge to new situations
- Assess the impacts and ethical effects of human technologies and actions
- Envision the long-term consequences of decisions

Heart (Emotional)

- Feel concern, empathy, and respect for other people and living things
- See from and appreciate multiple perspectives; work with and value others with different backgrounds, motivations, and intentions
- Commit to equity, justice, inclusivity, and respect for all people

Hands (Active)

- Create and use tools, objects, and procedures required by sustainable communities
- Turn convictions into practical and effective action, and apply ecological knowledge to the practice of ecological design
- Assess and adjust uses of energy and resources

Spirit (Connectional)

- Experience wonder and awe toward nature
- Revere the Earth and all living things
- Feel a strong bond with and deep appreciation of place
- Feel kinship with the natural world and invoke that feeling in others

Teaching ecological literacy often involves the following:

- Weaving ecological and systems approaches into the existing curriculum in a coherent way that builds student knowledge over time (Note: The focus should be on ecological concepts and their relationships to each other—both the big picture and the details—and to the active preservation of the ecosphere rather than incremental inclusion of ecological concepts.)
- Building teacher capacity in the areas of ecology and systems thinking
- Learning from nature through immersion in the real world (nature and communities) and a deep knowledge of particular places
- Acknowledging that place-based and experiential outdoor learning is essential to the cognitive development, health, and well-being of children
- Cultivating a sense of wonder, creativity, and compassion for nature and for community
- Transforming the school into a living laboratory of buildings and processes that teach children about their interconnectedness to nature and their communities
- Linking to higher education resources and schools that allow students to continue the development of their ecological literacy

A list of resources is included following the appendices to further support curriculum development. This is a relatively new field. It is a rich area to explore and take leadership in shaping ecological literacy and in nurturing the next generation of empowered students and sustainable communities.

Ecological Literacy Resources

Ecological Literacy

Stone, Michael K. and the Center for Ecoliteracy. *Smart by Nature: Schooling for Sustainability.* Bristol, UK: Watershed Media, 2009.

Stone, Michael K. and Zenobia Barlow (eds.) *Ecological Literacy: Educating Our Children for a Sustainable World*. San Francisco, CA: Sierra Club Books, 2005.

Orr, David W. *Ecological Literacy.* New York, NY: SUNY Press, 1991.
www.davidworr.com/books.html

Capra, Frijof. *The Web of Life: A New Scientific Understanding of Living Systems.* New York, NY: Ancor Books, 1996.

___. *The Hidden Connections: A Science for Sustainable Living.* New York, NY: Anchor Books, 2002.

___. *Uncommon Wisdom*. New York, NY: Simon and Schuster, 1988.

Ecological Literacy Part 1
http://www.youtube.com/watch?v=vohcled-kto

Ecological Literacy Part 2
http://www.youtube.com/watch?v=7RZ-_C3sIt4

Ecological Literacy Part 3
http://www.youtube.com/watch?v=7RZ-_C3sIt4

Goleman, Daniel. *Ecological Intelligence.* New York, NY: Broadway Books, 2009.
http://danielgoleman.info/topics/ecological-intelligence/

Berkowitz, Alan R., Mary E. Ford, and Carol A. Brewer. "A Framework for Integrating Ecological Literacy, Civics Literacy, and Environmental Citizenship in Environmental Education." In *Environmental Education or Advocacy: Perspectives of Ecology and Education in Environmental Education.* E.A. Johnson and M.J. Mappin (eds.), Cambridge University Press. pp. 227–266.

Hoelscher, David W. "Cultivating the Ecological Conscience: Smith, Orr, and Bowers on Ecological Education." M.A. thesis, University of North Texas, 2009.
http://digital.library.unt.edu/ark:/67531/metadc12133/m1/

Websites

David W. Orr.
www.davidworr.com/

Frijof Capra.
www.fritjofcapra.net/

Systems Thinking

Senge, Peter, Nelda Cambron-McCabe, Timothy Lucas, Bryan Smith, Janis Dutton, and Art Kleiner. *Schools that Learn: A Fifth Discipline Fieldbook for Parents, Educators and Everyone who Cares about Education.* New York, NY: Doubleday, 2000.

Senge, Peter. “Why change is so challenging for schools: An interview with Peter Senge.” www.learningforward.org/news/jsd/senge223.cfm

Meadows, Donella. *Leverage Points: Places to Intervene in a System.* Hartland, VT: The Sustainability Institute, 1999.

Meadows, Donella**.** *The Global Citizen.* Washington, DC: Island Press, 1991.

Wright, Diana (ed.). *Thinking in Systems.* White River Junction, VT: Chelsea Green Publishing, 2008.

Websites

Systems Thinking World
This site offers a Systems Thinking World discussion group, free online webinars, and more.

System Dynamics Listserv
The K–12 system dynamics listserv is a useful resource for practitioners who are applying systems thinking in the classroom.
http://sysdyn.clexchange.org/k-12sd-email-list

Linda Booth Sweeney
www.lindaboothsweeney.com

Pegasus Communications
www.pegasuscom.com/

The Resilience Alliance
www.resalliance.org

Society for Organizational Learning
www.solonline.org

Creative Learning Exchange
www.clexchange.org/

The Waters Foundation
This site offers first-class web-ed tutorials focused on systems thinking in K–12 education.
www.watersfoundation.org/webed/

Design Inspired by Nature

McDonough, William, and Michael Braungart. *Cradle to Cradle: Remaking the Way We Make Things.* New York, NY: North Point Press, 2002.
www.mcdonough.com/cradle_to_cradle.htm

Benyus, Janine. *Biomimcry: Innovation Inspired by Nature.* New York, NY: Harper Collins, 1997. www.biomimicry.net

Wilson, Edward O. *Biophilia.*
www.worldchanging.com/archives/000664.html

David W. Orr. *The Nature of Design: Ecology, Culture, and Human Intention.* Oxford, UK: Oxford, 2002.

AIGA's Living Principles for Design
www.livingprinciples.org/

Inhabitat. *Green Design Will Save the World.*
http://inhabitat.com/about/

The Designers Accord
www.designersaccord.org/

Centre for Child Honouring
http://childhonouring.org/

Sense of Place

Wendell Berry
www.wendellberrybooks.com/

Experiential Education Canada
www.experientialeducation.ca/

Association for Environmental and Outdoor Education
http://aeoe.org/

Global, Environmental, and Outdoor Education Council
Free lesson plans, divided by grade.
www.geoec.org/lessons/index.html

Richard Louv
http://richardlouv.com/

Louv, Richard. *Last Child in the Woods: Saving Our Children from Nature Deficit Disorder.* New York, NY: Algonquin Books, 2005.
http://richardlouv.com/last-child-woods

Leave No Child Inside Movement
www.kidsoutside.info/

Eco-literacy in Higher Education

Second Nature: Education for Sustainability
www.secondnature.org/

Higher Education Network for Sustainability and the Environment (HENSE)
www.ulsf.org/pub_declaration_othvol33.html

North American Alliance for Green Education
www.naage.org/

Other Resources in Environmental Education

Learning for a Sustainable Future
www.lsf-lst.ca/en

UN Decade of Education for Sustainable Development
www.unesco.org/en/esd/

UNESCO Teaching and Learning for a Sustainable Future Report
www.unesco.org/education/tlsf/

Giraffe Heroes program
www.giraffe.org

David Suzuki: Environmental Education in the Classroom
www.davidsuzuki.org/kids/teachers/classroom.html

Cowichan Valley Regional District. *Earth Issues: Our Lifestyles and the Environment: An Environmental Education Manual for Children Grades K through 5* (free PDF).
http://cvrd.bc.ca/documents/Engineering%20Services/Solid%20Waste/Education%20and%20Outreach/Manual%20Feb%2021%20LR.PDF

Eco-Kids
www.ecokids.ca/pub/index.cfm

Ecological Footprint Calculators
www.kidsfootprint.org
www.zerofootprintkids.com/kids_teacher.aspx?cat_id=9

Environment Canada Educator Resources
Provides access to featured lesson plans and links (divided for ages 6–12 and ages 13–18).
www.on.ec.gc.ca/community/youth/ec-educators-e.html

Includes lesson plans and info about free educational programming that may take place in your area.
www.ec.gc.ca/education/default.asp?lang=En&n=D3D10112-1

Environment Canada. *Explore Water with Holly Heron.*
Activity booklet provided by Girl Guides Canada, experiments. Suitable for Grades 1–3
www.ec.gc.ca/eau-water/default.asp?lang=En&n=88C2C5AD-1

Environmental Protection Agency (EPA)
www.epa.gov/teachers/teachresources.htm

Green Teacher Magazine
www.greenteacher.com/

The Groundwater Foundation
Kids Page and Sample Educator Resources
www.groundwater.org/kc/kc.html

One Simple Act – Alberta (Grades 1–6)
http://onesimpleactalberta.com/get-involved/school- toolkit.asp

Re-Energy.ca
Renewable energy project plans to build working models, teacher resources.
www.re-energy.ca/t_teacher.shtml

Resources for Rethinking
http://r4r.ca/en/

The Story of Stuff
A free 20-minute video that explains the cradle-to-grave, production to disposal cycle of our "stuff."
www.storyofstuff.com/

Other Print Resources

Appelhof, Mary. *Worms Eat My Garbage*. Kalamazoo, MI: Flower Press, 1997.

Appelhof, Mary, Mary Frances Fenton, and Barbara Loss Harris. *Worms Eat Our Garbage: Classroom Activities for a Better Environment*. Kalamazoo, MI: Flowerfield Enterprises, 1993.

Payne, Binet. *The Worm Café: Mid-Scale Vermicomposting of Lunchroom Wastes.* Kalamazoo, MI: Flower Press, 2003.

Cronin, Doreen. *Diary of a Worm.* Harry Bliss (illustrator). New York, NY: HarperCollins, 2003.

David, Laurie, and Cambria Gordon. *The Down-to-Earth Guide to Global Warming*. New York, NY: Orchard Books, 2007.

Grant, Tim, and Gail Littlejohn (eds.). *Greening School Grounds: Creating Habitats for Learning.* Toronto, ON: Green Teacher, 2001.

___. *Teaching Green: The Elementary Years*. Gabriola Island, BC: New Society Publishers, 2005.

___. *Teaching Green: The Middle Years*. Gabriola Island, BC: New Society Publishers, 2004.

___. *Teaching Green: The High School Years.* Gabriola Island, BC: New Society Publishers, 2009.

___. *Teaching about Climate Change: Cool Schools Tackle Global Warming*. Toronto, ON: Green Teacher, 2001.

Gutman, Dan (ed.). *Recycle This Book: 100 Top Children's Authors Tell You How to Go Green.* New York, NY: Yearling, 2009.